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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER				
HALL, ASHA J				
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/790,759

Applicant(s)

MARUYAMA, EIJI

Examiner

ASHA HALL

Art Unit

1795

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 31 December 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5, 8-11, 14-16, 19 and 20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) 1-5, 8-11, 14-16, 19 and 20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/888)
Paper No(s)/Mail Date March 7, 2008
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on December 31, 2007 has been entered.

Information Disclosure Statement

2. The non-patent document entitled "Chinese Office, with English translation issued Chinese Patent Application No. CN 2004100084944, mailed December 7, 2007", listed on the information disclosure statement filed on March 7, 2008, fails to comply with the provisions of 37 CFR 1.97, 1.98, and MPEP § 609, because this reference must have a publication date. It has been placed in the application file, but the information referred to therein has not been considered as to the merits. See MPEP § 609.05(a).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1 - 5, 15, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Inoue et al. (US Patent 5,344,498) in view of Neerincx et al. (D.G. Neerincx and T.J. Vink, Thin Solid Films 278 (1996) pp.12-17) and in further view of Adurodija et al. (F.O. Adurodija, H. Izumi, T. Ishihara, H. Yoshioka and M. Motoyama, J. Appl. Phys. 88 (2000) pp.4175-4180).

As to claim 1, Inoue et al. teaches a photovoltaic device (a-Si solar cell element, 100, Figure 1) comprising: a photoelectric conversion layer (a-Si semiconductor layer, 103; Column 7, lines 22 - 26) receiving light incident from the front surface side (i.e., incident on the side of the element bounded by 104); and wherein a collector (105) (col. 7; lines: 26-27) is formed on a transparent conductive film (transparent conductive layer, 104), formed on the front surface of said photoelectric conversion layer, wherein the transparent conductive layer is indium oxide (indium tin oxide, ITO, Column 8, lines 6 - 11). Inoue fails to provide an explicit disclosure of indium oxide layers having (222) plane orientation with two (222) peaks in said indium oxide layer.

Neerincx et al. disclose an indium tin oxide film suitable for use in optoelectronic applications as a transparent conductor (Introduction, 1st paragraph). As shown in Figure 1, this film has a (222) plane orientation with two (222) peaks ("doublet-type peak profile," figure caption) in its x-ray diffraction spectrum. It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the ITO films taught by Neerick et al. as the transparent conductor in the device of Inoue et al. in order to provide low resistivity and high transmissivity to visible light in the electrode (Introduction, 1st paragraph). Further, Inoue et al. suggests using ITO deposited using

the general methods, sputtering, used by Neerincx et al. However, the modified device of Inoue et al. lacks a specification that the content of Sn in the indium tin oxide layer with respect to In is at least about 2 percent by weight and not more than about 7 percent by weight.

Adurodija et al. teach a series of composition for ITO films that may be used in "many optoelectronic applications, including flat panel displays and solar cells" (Introduction, first paragraph). As Adurodija et al. show in Figure 4a, the carrier concentration of these films increases with weight % of Sn from 0-6 wt. % and then either decreases or levels off from 6-10 wt. % Sn. Thus, Adurodija et al. show in this figure that the maximum carrier concentration for these films occurs around 6 wt. % Sn.

Adurodija et al. disclose in first paragraph of the introduction that high carrier concentration and low resistivity are optimal for use in solar cell applications as transparent conductors. It would have been obvious to one of ordinary skill in the art at the time of the invention to choose a composition of the tin oxide layer used as the transparent conductive layer in the device of Inoue et al. that is around 6 wt. % Sn as instructed by Adurodija et al. in order to optimize the carrier concentration of the film.

As to claim 2, the photovoltaic device of Inoue et al. comprises a semiconductor layer (a-Si semiconductor layer, 103; Column 7, lines 22 - 26), formed on said transparent conductive film, that consists of an amorphous semiconductor (i.e., amorphous silicon).

As to claim 3, said (222) peaks in Figure 1 of Neerincx et al. for the indium tin oxide transparent conductor include: a first peak having an X-ray diffraction angle, 2θ , of about 30.1 ± 0.1 degrees, and a second peak having an X-ray diffraction angle, 2θ , of about 30.6 ± 0.1 degrees.

As to claim 4, the ratio (11/12) of the intensity of said first peak (11 = 2.5, in arbitrary units, according to Figure 1 of Neerincx et al.) to the intensity of said second peak (12 = 5.5, in arbitrary units, according to Figure 1) is approximately 0.46.

As to claim 5, the ratio (11/12) of the intensity of said first peak (11 = 2.5, in arbitrary units, according to Figure 1 of Neerincx et al.) to the intensity of said second peak (12 = 5.5, in arbitrary units, according to Figure 1) is approximately 0.46.

As to claim 15, the photovoltaic device (a-Si solar cell element, 100, Figure 1) of Inoue et al. is a device that has a transparent conductive film (transparent conductive layer, 104) and comprises: a substrate (substrate, 101); and a transparent conductive film (transparent conductive layer, 104), formed on said substrate and wherein a collector (105) (col. 7; lines: 26-27). While the transparent conductive layer disclosed by Inoue et al. is generic, it suggests an indium oxide layer (indium tin oxide, ITO) as the transparent conductive layer in column 8, lines 6 - 11. Inoue fails to provide is an explicit disclosure of indium oxide layers having (222) plane orientation with two (222) peaks in said indium oxide layer.

Neerincx et al. disclose an indium tin oxide film suitable for use in optoelectronic applications as a transparent conductor (Introduction, 1st paragraph). As shown in

Figure 1, this film has a (222) plane orientation with two (222) peaks ("doublet-type peak profile," figure caption) in its x-ray diffraction spectrum. It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the ITO films taught by Neerick et al. as the transparent conductor in the device of Inoue et al. in order to provide low resistivity and high transmissivity to visible light in the electrode (Introduction, 1st paragraph). Further, Inoue et al. suggests using ITO deposited using the general methods, sputtering, used by Neerick et al. However, the modified device of Inoue et al. lacks a specification that the content of Sn in the indium tin oxide layer with respect to In is at least about 2 percent by weight and not more than about 7 percent by weight.

Adurodija et al. teach a series of composition for ITO films that may be used in "many optoelectronic applications, including flat panel displays and solar cells" (Introduction, first paragraph). As Adurodija et al. show in Figure 4a, the carrier concentration of these films increases with weight % of Sn from 0-6 wt. % and then either decreases or levels off from 6-10 wt. % Sn. Thus, Adurodija et al. show in this figure that the maximum carrier concentration for these films occurs around 6 wt. % Sn. Adurodija et al. disclose in first paragraph of the introduction that high carrier concentration and low resistivity are optimal for use in solar cell applications as transparent conductors. It would have been obvious to one of ordinary skill in the art at the time of the invention to choose a composition of the tin oxide layer used as the transparent conductive layer in the device of Inoue et al. that is around 6 wt. % Sn as instructed by Adurodija et al. in order to optimize the carrier concentration of the film.

As to claim 16, said (222) peaks of said indium tin oxide transparent conductor of Neerincx et al. include: a first peak having an X-ray diffraction angle, 2θ , of about 30.1 ± 0.1 degrees, and a second peak having an X-ray diffraction angle, 2θ , of about 30.6 ± 0.1 degrees (Figure 1).

5. Claims 8-11, 14, 19 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakamura et al. (US Patent 7,030,413 B2) in view of Vink et al. (T.J. Vink, W. Walrave, J.L.C. Daams, P.C. Baarslag, J.E.A.M. van den Meerakker, Thin Solid Films 266 (1995) pp.145-151) and in further view of Adurodija et al. (F.O. Adurodija, H. Izumi, T. Ishihara, H. Yoshioka and M. Motoyama, J. Appl. Phys. 88 (2000) pp.4175-4180).

As to claim 8, Nakamura et al. discloses a photovoltaic device (photovoltaic device, Figure 1) comprising: a first conductivity type crystalline semiconductor substrate (n-type single crystalline Si, 11) having a front surface and a back surface and receiving light incident from the side of said front surface; a substantially intrinsic first amorphous semiconductor layer (the layer formed by the combination of intrinsic amorphous SiC and Si, layers 13 and 14) formed on said front surface of said crystalline semiconductor substrate; a second conductivity type second amorphous semiconductor layer (p-type amorphous Si, 14) formed on said first amorphous semiconductor layer; and a transparent conductive film (transparent electrode, 15), formed on said second amorphous semiconductor layer. Nakamura discloses wherein a collector (16) is formed on the transparent conductive film (15) (col. 4; lines: 10-14). Nakamura teaches that the transparent conductive film is an indium oxide layer (indium tin oxide; Column 4, lines

34-35). What Nakamura fails to provide is an indium oxide layer having (222) plane orientation with two (222) peaks in said indium oxide layer.

Vink et al. disclose an indium tin oxide film suitable for use in optoelectronic applications as a transparent conductor (Introduction, 1st paragraph). The x-ray diffraction pattern of one such film, i.e., a film that is annealed and sputter-deposited at room temperature according to the teachings of Vink et al., appears in Figure 1 of Neernick et al. As shown in Figure 1, this film has a (222) plane orientation with two (222) peaks ("doublet-type peak profile," figure caption) in its x-ray diffraction spectrum. Further, Vink et al. report results showing that annealed, tin oxide films sputter deposited at room temperature on tin oxide films have low intrinsic stress (Conclusion paragraph, 2nd to last sentence). Vink et al. further disclose that the use of indium tin oxide films with low internal stress is advantageous to prevent deformation and fracture (Introduction, 1st paragraph). The indium oxide film of Nakamura et al. was sputter deposited at a substrate temperature of 180°C, well over 100°C in excess of room temperature, which would leave it prone to internal stress. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to replace the transparent conductive film in Nakamura et al. by a film sputter deposited at room temperature and annealed according to the teachings of Vink et al. in order to prevent deformation and fracture. However, the modified device of Nakamura et al. lacks a specification that the content of Sn in the indium tin oxide layer with respect to In is at least about 2 percent by weight and not more than about 7 percent by weight.

Adurodija et al. teach a series of composition for ITO films that may be used in "many optoelectronic applications, including flat panel displays and solar cells" (Introduction, first paragraph). As Adurodija et al. show in Figure 4a, the carrier concentration of these films increases with weight % of Sn from 0-6 wt. % and then either decreases or levels off from 6-10 wt. % Sn. Thus, Adurodija et al. show in this figure that the maximum carrier concentration for these films occurs around 6 wt. % Sn. Adurodija et al. disclose in first paragraph of the introduction that high carrier concentration and low resistivity are optimal for use in solar cell applications as transparent conductors. It would have been obvious to one of ordinary skill in the art at the time of the invention to choose a composition of the tin oxide layer used as the transparent conductive layer in the device of Nakamura et al. that is around 6 wt. % Sn as instructed by Adurodija et al. in order to optimize the carrier concentration of the film.

As to claim 9, said (222) peaks in Figure 1 of Neerincx et al. include: a first peak having an X-ray diffraction angle, 2θ , of about 30.1 ± 0.1 degrees, and a second peak having an X-ray diffraction angle, 2θ , of about 30.6 ± 0.1 degrees.

As to claim 10, the ratio (I_{11}/I_{12}) of the intensity of said first peak ($I_{11} = 2.5$, in arbitrary units, according to Figure 1 of Neerincx et al.) to the intensity of said second peak ($I_{12} = 5.5$, in arbitrary units, according to Figure 1) is approximately 0.46.

As to claim 11, the ratio (I_{11}/I_{12}) of the intensity of said first peak ($I_{11} = 2.5$, in arbitrary units, according to Figure 1 of Neerincx et al.) to the intensity of said second peak ($I_{12} = 5.5$, in arbitrary units, according to Figure 1) is approximately 0.46.

As to claim 14, in the photovoltaic device of Nakamura et al. (photovoltaic device, Figure 1), said crystalline semiconductor substrate (n-type single crystalline Si, 11) is an n-type semiconductor substrate, and said second amorphous semiconductor layer is a p-type semiconductor layer (p-type amorphous Si, 14).

As to claim 19, in the photovoltaic device of Nakamura et al. (photovoltaic device, Figure 1), the first conductivity type single-crystalline silicon substrate (n-type single crystalline Si, 11) has a front surface and a back surface and receiving light on the side of said front surface; a substantially intrinsic first amorphous silicon layer formed on said front surface of said single- crystalline silicon substrate (the layer formed by the combination of intrinsic amorphous SiC and Si, layers 13 and 14); a second conductivity type second amorphous silicon layer formed on said first amorphous silicon layer (p-type amorphous Si, 14); and a transparent conductive film, formed on said second amorphous silicon layer, including an indium oxide (indium tin oxide, Column 4, lines 34-35). Nakamura discloses wherein a collector (16) is formed on on the transparent conductive film (15) (col. 4; lines: 10-14). What Nakamura fails to provide is an indium oxide layer having (222) plane orientation with two (222) peaks in said indium oxide layer.

Vink et al. disclose an indium tin oxide film suitable for use in optoelectronic applications as a transparent conductor (Introduction, 1st paragraph). The x-ray diffraction pattern of an example of one film sputter deposited at room temperature and annealed according to the teachings of Vink et al.. appears in Figure 1 of Neerinct et al.. As shown in Figure 1, this film has a (222) plane orientation with two (222) peaks

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("doublet-typepeak profile," figure caption) in its x-ray diffraction spectrum. Further, Vink et al. report results showing that annealed, tin oxide films sputter deposited at room temperature on tin oxide films have low intrinsic stress (Conclusion paragraph, 2nd to last sentence). Vink et al. further disclose that the use of indium tin oxide films with low internal stress is advantageous to prevent deformation and fracture (Introduction, 1st paragraph). The indium oxide film of Nakamura et al. was sputter deposited at a substrate temperature of 180°C, well over 100°C in excess of room temperature, which would leave it prone to internal stress. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to replace the transparent conductive film in Nakamura et al. by a film sputter deposited at room temperature and annealed according to the teachings of Vink et al. in order to prevent deformation and fracture. However, the modified device of Nakamura et al. lacks a specification that the content of Sn in the indium tin oxide layer with respect to In is at least about 2 percent by weight and not more than about 7 percent by weight.

Adurodija et al. teach a series of composition for ITO films that may be used in "many optoelectronic applications, including flat panel displays and solar cells" (Introduction, first paragraph). As Adurodija et al. show in Figure 4a, the carrier concentration of these films increases with weight % of Sn from 0-6 wt. % and then either decreases or levels off from 6-10 wt. % Sn. Thus, Adurodija et al. show in this figure that the maximum carrier concentration for these films occurs around 6 wt. % Sn. Adurodija et al. disclose in first paragraph of the introduction that high carrier concentration and low resistivity are optimal for use in solar cell applications as

transparent conductors. It would have been obvious to one of ordinary skill in the art at the time of the invention to choose a composition of the tin oxide layer used as the transparent conductive layer in the device of Nakamura et al. that is around 6 wt. % Sn as instructed by Adurodija et al. in order to optimize the carrier concentration of the film.

As to claim 20, said (222) peaks in Figure 1 of Neerincx et al. include:: a first peak having an X-ray diffraction angle, 2 θ , of about 30.1 + 0.1 degrees, and a second peak having an X-ray diffraction angle, 2 θ , of about 30.6 + 0.1 degrees.

Response to Arguments

35 U.S.C. 103(a) Rejection

6. With respect to claim 1-5, 15 and 16, the Applicant argues that as each and every limitation must be disclosed or suggested by the cited prior art references in order to establish a *prima facie* case of obviousness (see, M.P.E.P. §2143.03) and for at least the foregoing reasons the proposed combination of Inoue, Adurodija and Neerincx fails to do so.

The Examiner respectfully disagrees. For the reasons set forth above claims 1-5, 15, and 16 are unpatentable over Inoue et al. in view of Adurodija and Neerincx.

7. In regards to claims 8-14, 19 and 20, the Applicant argues that the proposed combination of Nakamura, Vink and Adurodija does not teach or suggest the claimed photovoltaic device in claims 8 and 19. Therefore, claims 8 and 19 and claims dependent thereupon are patentable over the combination of Aurodija, Nakamura and Vink.

The Examiner respectfully disagrees. For the reasons set forth above claims 8-14, 19, and 20, are unpatentable over Nakamura et al. in view of Aurodija and Vink.

Conclusion

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to ASHA HALL whose telephone number is (571)272-9812. The examiner can normally be reached on Monday-Thursday 8:30-7:00PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on 571-272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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/Alexa D. Neckel/

Supervisory Patent Examiner, Art Unit 1795